

## Five new lichen species (Ascomycota) and a new record from southern New South Wales, Australia

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### Abstract

Five lichen species (Ascomycota) are described as new from rocks in coastal and tableland localities of southern New South Wales: *Catillaria gerroana* P.M.McCarthy & Elix (Catillariaceae), *Fellhanera robusta* P.M.McCarthy & Elix (Pilocarpaceae), *Menegazzia fortuita* Elix & P.M.McCarthy (Parmeliaceae), *Ramboldia curvispora* P.M.McCarthy & Elix (Lecanoraceae) and *Sarcogyne maritima* P.M.McCarthy & Elix (Acarosporaceae). *Arthonia lapidicola* (Taylor) Branth & Rostrup (Arthoniaceae) is reported for the first time from Australia.

### Introduction

Recent joint field investigations by the authors and subsequent laboratory studies based on lichens collected from the South Coast and Southern Tablelands of New South Wales, adjacent parts of Victoria and the Australian Capital Territory have led to the discovery of new species as well as new national and state and territory records (McCarthy and Elix 2016, 2017, McCarthy et al. 2017, Elix and McCarthy 2017, 2018, Elix et al. 2017). In this contribution, five new species are documented from southern New South Wales representing the genera *Catillaria* A.Massal. (Catillariaceae), *Fellhanera* Vězda (Pilocarpaceae), *Menegazzia* A.Massal. (Parmeliaceae), *Ramboldia* Kantvilas & Elix (Lecanoraceae) and *Sarcogyne* Flot. (Acarosporaceae), along with a new Australian record of *Arthonia lapidicola* (Taylor) Branth & Rostrup (Arthoniaceae).

### Methods

Observations and measurements of photobiont cells, thalline and apothecial anatomy, asci, ascospores, pycnidial anatomy and conidia were made on hand-cut sections mounted in water and treated with 10% potassium hydroxide (K) and 50% nitric acid (N). Calcium oxalate was detected by treatment of thalline and apothecial sections with a 10% aqueous solution of sulfuric acid; it forms colourless, needle-shaped crystals. Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Chemical constituents were identified by thin-layer chromatography (Elix 2014) and comparison with authentic samples.

## New Species

### 1. *Catillaria gerroana* P.M.McCarthy & Elix *sp. nov.*

MycoBank No.: MB 821988

**Diagnosis:** Distinguished from *C. austrolittoralis* Kantvilas & van den Boom by the absence of lichen substances in the thallus (*C. austrolittoralis* produces argopsin or pannarin), and by the moderately to strongly convex or hemispherical apothecia with a rapidly excluded proper margin (rather than mostly plane to slightly convex and with a persistent margin).

**Type:** Australia, New South Wales, South Coast (Jacobs and Pickard 1981), Gerroa, Black Head, 34°46'36"S, 150°49'19"E, alt. 2–3 m, on sandstone cliffs on the foreshore, *J.A. Elix 46440*, 24 May 2017; holo: CANB.

*Thallus* crustose, epilithic,  $\pm$  determinate, continuous to sparingly or richly rimose, not areolate, smooth, dull to slightly glossy, pale to medium greyish green, to 80  $\mu\text{m}$  thick, forming colonies to 10 cm wide, ecorticate, containing abundant calcium oxalate ( $\text{H}_2\text{SO}_4$  +). *Algae* green, globose, chlorococcoid, 6–15(–18)  $\mu\text{m}$  wide; interstitial mycobiont hyphae short-celled, 2.5–4(–5)  $\mu\text{m}$  wide. *Prothallus* not apparent. *Apothecia* very numerous, lecideine to pseudobiatrine, solitary or merging or proliferating into groups of 2–4, initially adnate, becoming sessile, sessile or, on occasion, substipitate, rounded, broadly ellipsoid or more irregular in outline, (0.23–)0.35(–0.48) mm diam. [ $n = 85$ ]; disc initially plane, soon becoming convex and eventually strongly convex to hemispherical, smooth, dull dark green to greenish black, epruinose, the colour unchanged when wetted; margin at first indistinct and not prominent, concolorous with the disc, to 50  $\mu\text{m}$  wide, soon becoming excluded. *Proper excipulum* annular, non-carbonized, laterally with an outer, 10–17  $\mu\text{m}$  thick (basally 15–27  $\mu\text{m}$  thick), medium to dark brown zone, K–, N+ deep red-brown, the outermost cells rounded, thick-walled and most deeply pigmented, 3–5(–7)  $\mu\text{m}$  wide, subtended by dark brown, radiating-prosoplectenchymatous hyphae 1.5–2.5  $\mu\text{m}$  wide; inner excipular zone hyaline, 12–20  $\mu\text{m}$  thick, the hyphae tightly conglomerate, periclinal, 1.5–2.5  $\mu\text{m}$  wide. *Hypothecium* hyaline to very pale yellowish brown, 60–100(–120)  $\mu\text{m}$  thick in the centre of the apothecium, 30–50  $\mu\text{m}$  thick towards the excipulum, thickest when the hypothecium and inner, pale excipular tissue penetrate the thallus as a blunt, irregular stipe, thinnest when subtended by an upwelling of photobiont cells and thalline hyphae, usually interspersed with oil globules (especially distally), K– or with several small yellow-orange streaks, N–, I–, of rather loose, short-celled, variously orientated hyphae 2–3(–3.5)  $\mu\text{m}$  wide. *Hymenium* uniformly hyaline, 40–50  $\mu\text{m}$  thick, the basal area usually interspersed with granules; hymenial gel I+ blue. *Epihymenium* dark brown, 7–10(–12)  $\mu\text{m}$  thick, K–, N+ brown or olive-brown. *Paraphyses* not conglomerate in water, simple below, sparingly dichotomously branched in and immediately below the epihymenium, short- to long-celled, 1.5–2(–2.5)  $\mu\text{m}$  wide, the septa frequently constricted; apices usually markedly and abruptly swollen, 2.5–5(–7)  $\mu\text{m}$  wide, rounded, rather flattened or irregular, most with a well-defined, dark olive-brown, internal cap of pigment. *Asci* 8-spored, narrowly to broadly clavate or narrowly ellipsoid, 34–42  $\times$  10–17  $\mu\text{m}$  [ $n = 25$ ], with a tapering stalk, *Catillaria*-type; apex rounded, with a thick, uniformly amyloid tholus lacking an ocular chamber, plane or convex against the ascoplasm. *Ascospores* colourless, irregularly biserial in the ascus, 1-septate, narrowly ellipsoid, oblong or short-fusiform, with rounded or somewhat pointed ends, thin-walled, lacking a perispore, frequently slightly constricted at the septum, (9–)11.5(–15)  $\times$  (3.5–)4.5(–5.5)  $\mu\text{m}$  [ $n = 66$ ]; the contents usually granulose and/or guttulate. *Pycnidia* solitary, numerous, almost completely immersed in the thallus, convex and brown-black above, hyaline below, 60–80  $\mu\text{m}$  wide; conidiophores unbranched, to 10  $\mu\text{m}$  long; conidia narrowly ellipsoid to short-fusiform or oblong, 2–2.5(–3)  $\times$  1–1.5  $\mu\text{m}$ . **Figs 1, 2.**

**Chemistry:** Thallus K–, C–, KC–, PD–, UV–; no substances detected by TLC.

**Relationships:** That this new species belongs in the cosmopolitan genus *Catillaria* is confirmed by the combination of a chlorococcoid photobiont, lecideine apothecia, loose and sparingly branched paraphyses, *Catillaria*-type asci (with a uniformly and deeply amyloid tholus lacking an ocular chamber) and narrow, thin-walled, 1-septate ascospores. Moreover, it is clearly referable to the *C. chalybeia* (Borrer) A.Massal. group of species (*sensu* Kilius 1981) by virtue of its K– apothecial pigments and the apices of paraphyses being abruptly swollen and having an internal pigment cap. The diagnostically convex to hemispherical apothecia and rapidly excluded, brown (rather than coal-black) apothecial margin of *C. gerroana* distinguish it from the mainly boreal to northern-temperate, silicolous species *C. chalybeia* and *C. atomarioides* (Müll.Arg.) H.Kilius (Kilius 1981, Hertel et al. 2008, Fletcher and Coppins 2009) and the East Asian *C. ulleungdoensis* S.Y.Kondr., L.Lökös & J.-S. Hur (Kondratyuk et al. 2016). The widespread and mainly Northern Hemisphere lichen *C. lenticularis* (Ach.) Th.Fr. is exclusively calcicolous, has brown rather than black apothecia and smaller ascospores than those of *C. gerroana* (Kilius 1981, Hertel et al. 2008, Fletcher and Coppins 2009), and while the very rare *C. subviridis*

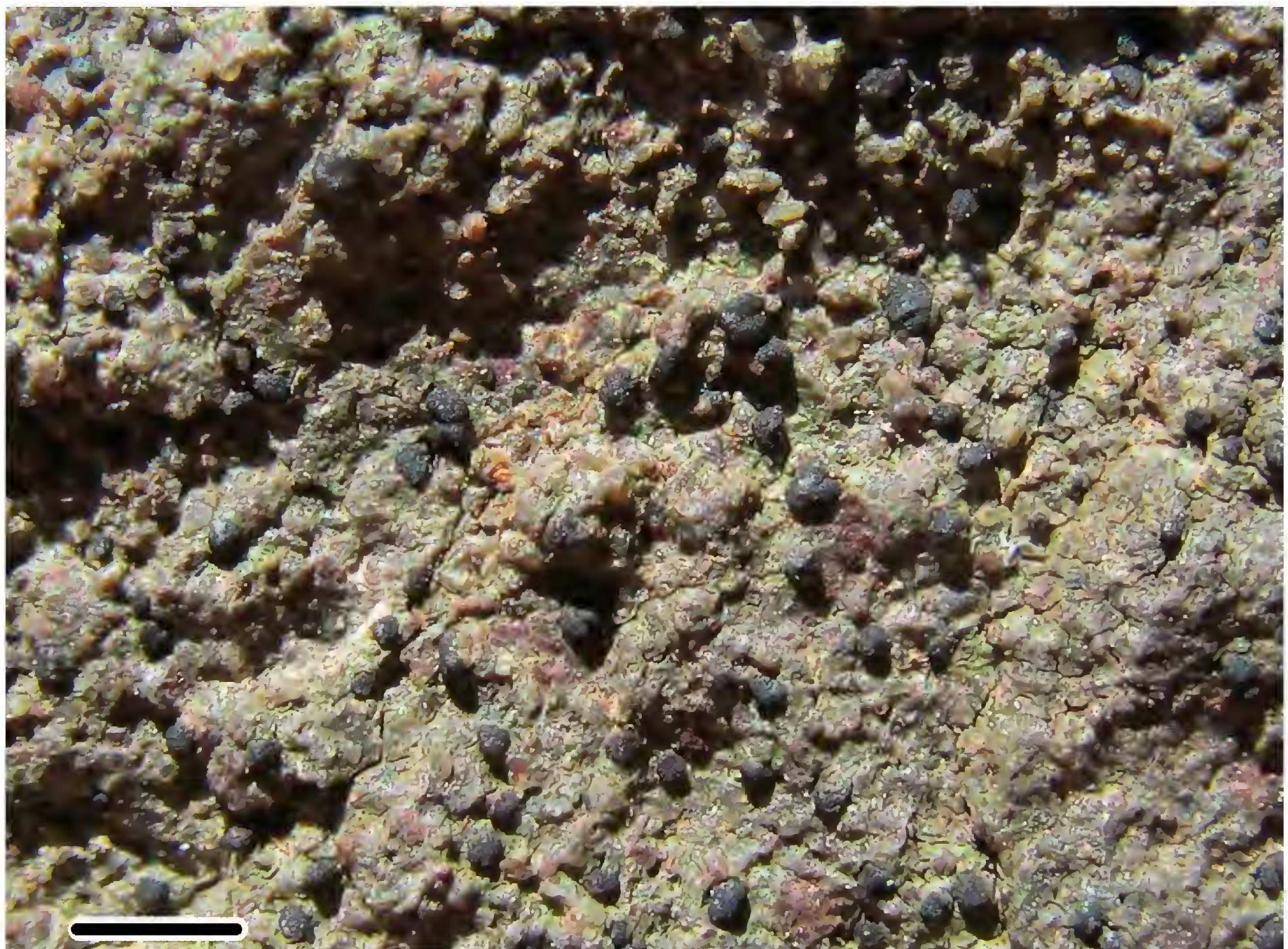


(Nyl.) Zahlbr., from western Europe and south-western North America, also occurs on coastal, siliceous rocks and has a comparatively pale, layered excipulum and colourless hypothecium (as in *C. gerroana*), the diminutive apothecia (0.1–0.3 mm wide) are concave to plane and the ascospores are significantly larger (Kilias 1981, Hertel et al. 2008, Fletcher and Coppins 2009). Other species in this group include *C. gilbertii* Fryday & Coppins, a montane species endemic to Britain, with 16-spored asci (Fryday and Coppins 1996) and the calcicolous *C. glaucogrisea* Fryday, from Campbell Island, New Zealand, which has a pale grey, areolate thallus and concave to plane apothecia with a blue-black epihymenium (Fryday 2004). While the aforementioned species, including *C. gerroana*, all lack thalline lichen substances, *C. austrolittoralis*, known from coastal siliceous rocks in South Australia, Tasmania, Victoria and southern New South Wales, is characterized, *inter alia*, by the thallus containing the  $\beta$ -orcinol depsidones argopsin or pannarin (Kantvilas and van den Boom 2013). It is further distinguished from *C. gerroana* by its usually thicker predominantly grey and areolate thallus and plane to slightly convex apothecia with a persistent proper margin. It is worth mentioning that while *C. chalybeia* and *C. lenticularis* have been reported from Western Australia (Richardson and Richardson 1982, McCarthy 2017), the specimens upon which those records are based require reassessment.

**Etymology:** The specific epithet refers to the type locality, Gerroa, New South Wales, Australia.

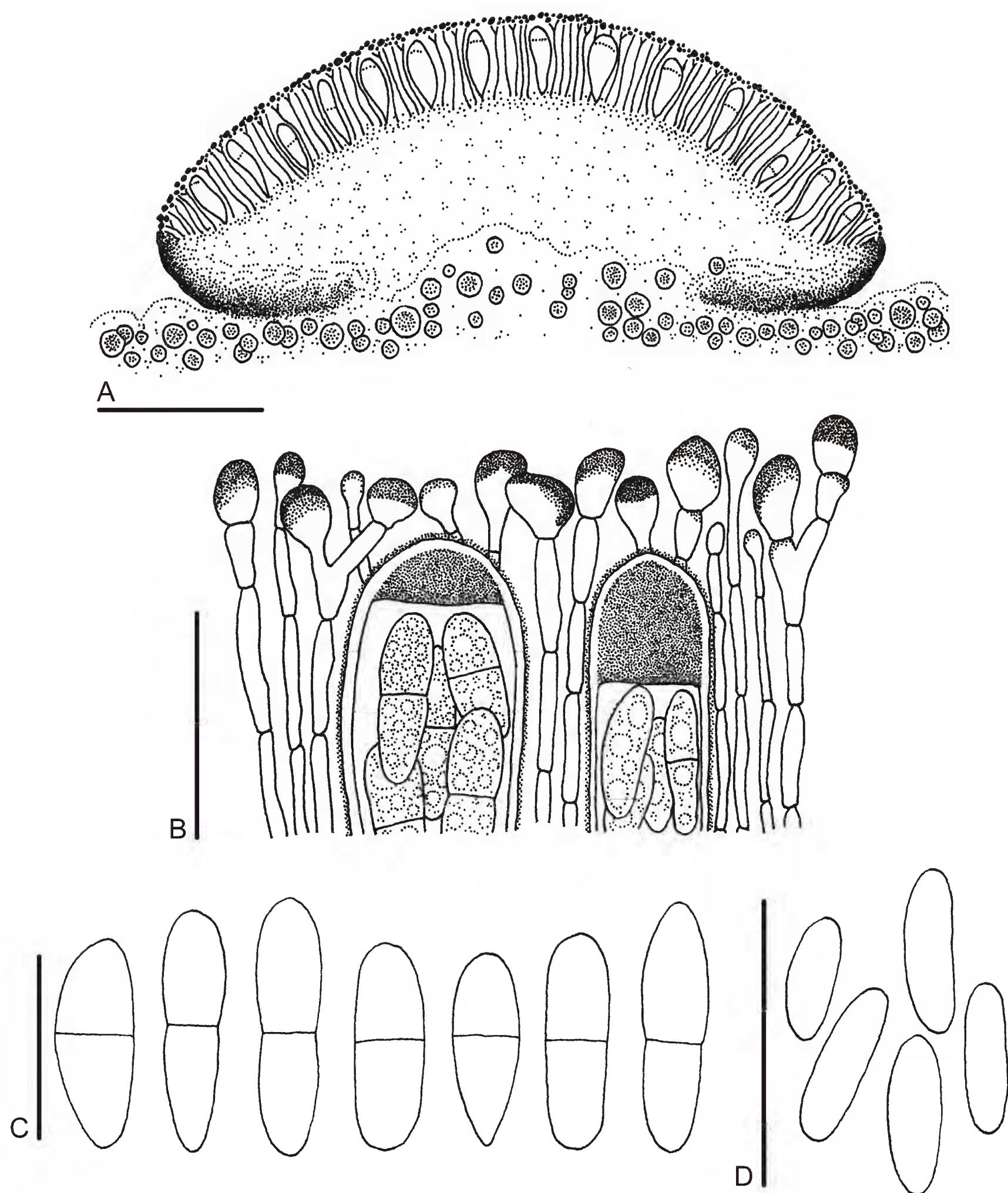
**Distribution and habitat:** The new species is known only from sandstone rocks on the seashore at the type locality, *viz.* Black Head, near Gerroa, on the south coast of New South Wales. Associated lichens include *Buellia cranwelliae* Zahlbr., *Caloplaca* spp., *Rinodinella fertilis* (Körb.) Elix var. *fertilis* and *R. fertilis* var. *hypostictica* (Elix) Elix, *Pertusaria melanospora* var. *sorediata* Elix & A.W.Archer and *Verrucaria aff. fusconigrescens* Nyl.

**Additional specimen examined:** NEW SOUTH WALES: type locality, P.M. McCarthy 4601, 24 May 2017 (CANB).



**Fig 1.** *Catillaria gerroana* (holotype). Scale bar = 2 mm.





**Fig 2.** *Catillaria gerroana* (holotype). A, Sectioned apothecium and adjacent thallus (semi-schematic); B, Mature and submature asci stained with Lugol's iodine after pre-treatment with K, and paraphyses; C, Ascospores; D, Conidia. Scale bars: A = 0.1 mm; B = 20 µm; C = 10 µm; D = 5 µm.

**2. *Fellhanera robusta* P.M.McCarthy & Elix *sp. nov.***

MycoBank No.: MB 821989

**Diagnosis:** Distinguished from *F. incolorata* P.M.McCarthy & Elix by the saxicolous, verrucose, bullate or cerebriform thallus up to 2.5 mm thick (corticolous, verruculose and up to 0.12 mm in the latter), containing atranorin and norgangaleoidin (rather than atranorin and thuringione), shorter ascospores,  $8\text{--}15 \times 3.5\text{--}7\text{ }\mu\text{m}$  ( $11\text{--}18 \times 4\text{--}6\text{ }\mu\text{m}$  in *F. incolorata*) and smaller, globose conidia,  $1.5\text{--}2.5\text{ }\mu\text{m}$  diam. (broadly pyriform and  $2.5\text{--}3.5 \times 2\text{--}2.5\text{ }\mu\text{m}$  in *F. incolorata*).



**Type:** Australia. New South Wales, South Coast, Jervis Bay, Callala Bay, 0.5 km W of Callala Point, 35°00'22"S, 150°43'07"E, alt. 0.5–2 m, on unstable, vertical shale cliff receiving sea spray and soil runoff from above, P.M. McCarthy 4570, 19 Apr 2017; holo: CANB.

*Thallus* crustose, epilithic, forming discrete, often orbicular colonies to 5 cm wide, the older parts commonly eroding and leaving thin, marginal arcs of thallus, pale to medium greyish green, verrucose-areolate (the verrucae to 0.5 mm wide) and up to 0.2 mm thick near the margin, inner parts pale greenish grey to white, the verrucae becoming more prominent, bullate to irregularly cerebriform, to 4 mm wide and up to 1.5(–2.5) mm thick. *Cortex* indistinct, the outermost 10–18(–25) µm of the thallus free of algae, amorphous and minutely crystalline to obscurely paraplectenchymatous, the cells (in K) rounded to irregular, hyaline, thick-walled, c. 5 µm wide. *Algal layer* continuous, discrete and 30–80(–120) µm thick; cells green, chlorococcoid, often rather thick-walled, (5–)8–16(–21) µm diam.; interstitial hyphae 1.5–2 µm wide. *Medulla* well delimited, thick and white when the thallus is cut vertically, containing abundant calcium oxalate ( $\text{H}_2\text{SO}_4$  +), I–; hyphae forming a compact network, thin-walled, short- to long-celled and richly branched, 2–4 µm wide. *Prothallus* not apparent or thin, effuse, whitish and up to 1 mm wide. *Apothecia* sparse to moderately numerous, adnate to subsessile, not or slightly constricted at the base, borne mainly on bullate verrucae and the most convoluted-cerebriform parts of the thallus, lecideine or biatorine, solitary and rounded to rather irregular, (0.4–)0.7(–1.1) mm diam. [ $n = 42$ ], or in convex to subglobose clusters of up to 6 merging or proliferating apothecia, (0.7–)1.3(–2.1) mm diam. [ $n = 12$ ], creamy white or with a faint greenish tint, somewhat translucent when moist, largely unpigmented in section; margins distinct but not prominent in most apothecia, concolorous with the disc, smooth, entire, slightly glossy, 60–100 µm thick in surface view, persistent or becoming excluded around the most convex apothecia; disc initially plane, usually becoming slightly convex or undulate, rarely strongly convex at maturity, smooth, dull, epruinose. *Thalline excipulum* absent. *Proper excipulum* well-developed, colourless throughout or very pale greenish laterally (pigment clearing in K), broadly annular and with a narrow central gap to cupulate,  $\pm$  paraplectenchymatous, 50–70(–80) µm thick laterally (thin section), 70–130 µm thick at the base, internally opaque and heavily impregnated with a  $\pm$  continuous, 50–100 µm thick layer of calcium oxalate ( $\text{H}_2\text{SO}_4$  +), the basal 15–30 µm and a well-defined, 15–25 µm thick layer subtending the hypothecium lacking calcium oxalate; outermost lateral cells ellipsoid or more rounded than subtending cells, tightly packed, rather thick-walled, 2.5–5 µm in maximum extent; subtending cells  $5\text{--}10 \times 2\text{--}4$  µm; subhypothecial cells tightly packed, thick-walled, somewhat periclinally elongate, 2–3 µm wide. *Epihymenium* 10–15(–20) µm thick, opaque in water and dominated by dense, minute, colourless crystals that mostly dissolve in K. *Hypothecium* colourless, 35–65 µm thick, minutely paraplectenchymatous, K–, I+ blue, N–; upper half inspersed with minute granules; lower half not. *Hymenium* 50–65 µm thick, inspersed with granules near the base or not (hymenial and hypothecial granules dissolving in K), I+ blue, K–; *paraphyses* tightly conglutinate in water, only a little looser in K, mostly unbranched, often sparingly branched below the apices, lacking anastomoses, long-celled, 1–1.5 µm thick; apices not or scarcely swollen (clavate and up to 2 µm wide), not pigmented. *Asci* narrowly to broadly clavate or cylindroclavate, *Byssoloma*-type (Hafellner 1984), 8-spored,  $39\text{--}60 \times 10\text{--}18$  µm [ $n = 20$ ]. *Ascospores* colourless, irregularly biserial in the ascus, 1-septate at maturity, narrowly ellipsoid to oblong-ellipsoid or oblong, usually straight, the septum median or slightly submedian, or the proximal cell narrower and more pointed than the distal, often constricted at the septum,  $(8\text{--})12\text{--}(15) \times (3.5\text{--})5\text{--}(7)$  µm [ $n = 31$ ], thin-walled, lacking a perispore; apices rounded to subacute; contents clear or granular to vacuolate. *Pycnidia* moderately numerous, immersed in bullate and cerebriform areas of the thallus, rounded to pyriform, 100–120(–140) µm wide; apex outwardly greenish black to black, 80–120(–140) µm wide, K–, slightly concave to slightly convex, then occasionally with a minutely papillate ostiole; apical wall dull greenish black in section, 25–35 µm thick; lateral and basal walls hyaline to medium greenish brown, 7–10 µm thick; conidiogenous layer simple, the conidiophores unbranched, 10–18 µm long, 1–1.5 µm thick, some apices retaining a faint, cup-like remnant following conidial budding; conidia predominantly globose, 1.5–2.5 µm diam., a small minority broadly ellipsoid, subglobose or ovoid. **Figs 3, 4.**

**Chemistry:** Thallus K+ yellow, C–, KC+ red, PD–, UV–; containing atranorin (major) and norgangaleoidin (minor) by TLC.

**Relationships:** The circumscription of the predominantly foliicolous and tropical and subtropical genus *Fellhanera* was outlined by Elix and McCarthy (2017) in the context of the newly described *F. incolorata* P.M. McCarthy & Elix from mangrove bark in southern New South Wales. Both *F. robusta* and *F. incolorata* represent the *F. bouteillei* (Desm.) Vězda group of species, which is characterized by comparatively pale apothecia that produce persistently 1-septate ascospores. The new species is distinguished by its thick, variously verrucose, bullate or contorted, whitish, saxicolous thallus containing atranorin and norgangaleoidin, concolorous apothecia that are heavily impregnated with calcium oxalate, and globose conidia. By contrast,



the corticolous *F. incolorata* has a much thinner and more-or-less uniformly verruculose thallus producing atranorin and thuringione, longer ascospores and larger, broadly pyriform conidia (Elix and McCarthy 2017). A comparison with other saxicolous species of the *F. bouteillei* species group confirms the integrity of the new species. Thus, the recently described *F. maritima* L.Lökös, S.Y.Kondr. & J.-S.Hur, from Korea, has a whitish, minutely areolate thallus and pale apothecia that are 0.15–0.3(–0.5) mm diam., while the ascospores are (8–)9–11(–13)  $\times$  (3–)3.5–4(–4.8)  $\mu\text{m}$  and the conidia are elongate and 3–4  $\times$  1–1.5(–1.8)  $\mu\text{m}$  (Kondratyuk et al. 2013). The subcosmopolitan and multisubstratic *F. bouteillei* has a bluish grey or bluish green and granulose thallus containing usnic and isousnic acids, pale yellowish to orange-brown or pale brown apothecia 0.1–0.4 mm diam. and narrowly pyriform conidia 3–5  $\times$  1.5–2  $\mu\text{m}$  (van den Boom 2004, Lücking 2008, Aptroot et al. 2009).

**Etymology:** The specific epithet refers to the verrucose-areolate to bullate or irregularly cerebriform thallus of *F. robusta*.

**Distribution and habitat:** *Fellhanera robusta* is known only from a 4–5 metre tall, vertical shale cliff at Callala Bay on the northern shores of Jervis Bay, New South Wales. This remarkable site, influenced both by the deposition of seaspray and soil leachates trickling from above, has a highly distinctive lichen flora only on a c. 50 metre long stretch of soft, almost mud-like and crumbling shale (Fig. 5); lichens are almost completely absent elsewhere on the shore. The community is dominated by *F. robusta* and the newly described *Ramboldia curvispora* (see below) and a new species of *Porpidia* (see Elix and McCarthy 2018), as well as *Opegrapha* aff. *diaphoriza* Nyl. Also present are scattered colonies of *Acarospora citrina* (Taylor) Zahlbr. ex Rech., *Amandinea julianae* H.Mayrhofer & Elix, *Arthonia lapidicola* (see below), *Buellia* spp., *Physcia littoralis* Elix and *Scoliciosporum umbrinum* (Ach.) Arnold.

**Additional specimen examined:** NEW SOUTH WALES: type locality, P.M. McCarthy 4578, 23 May 2017 (CANB).

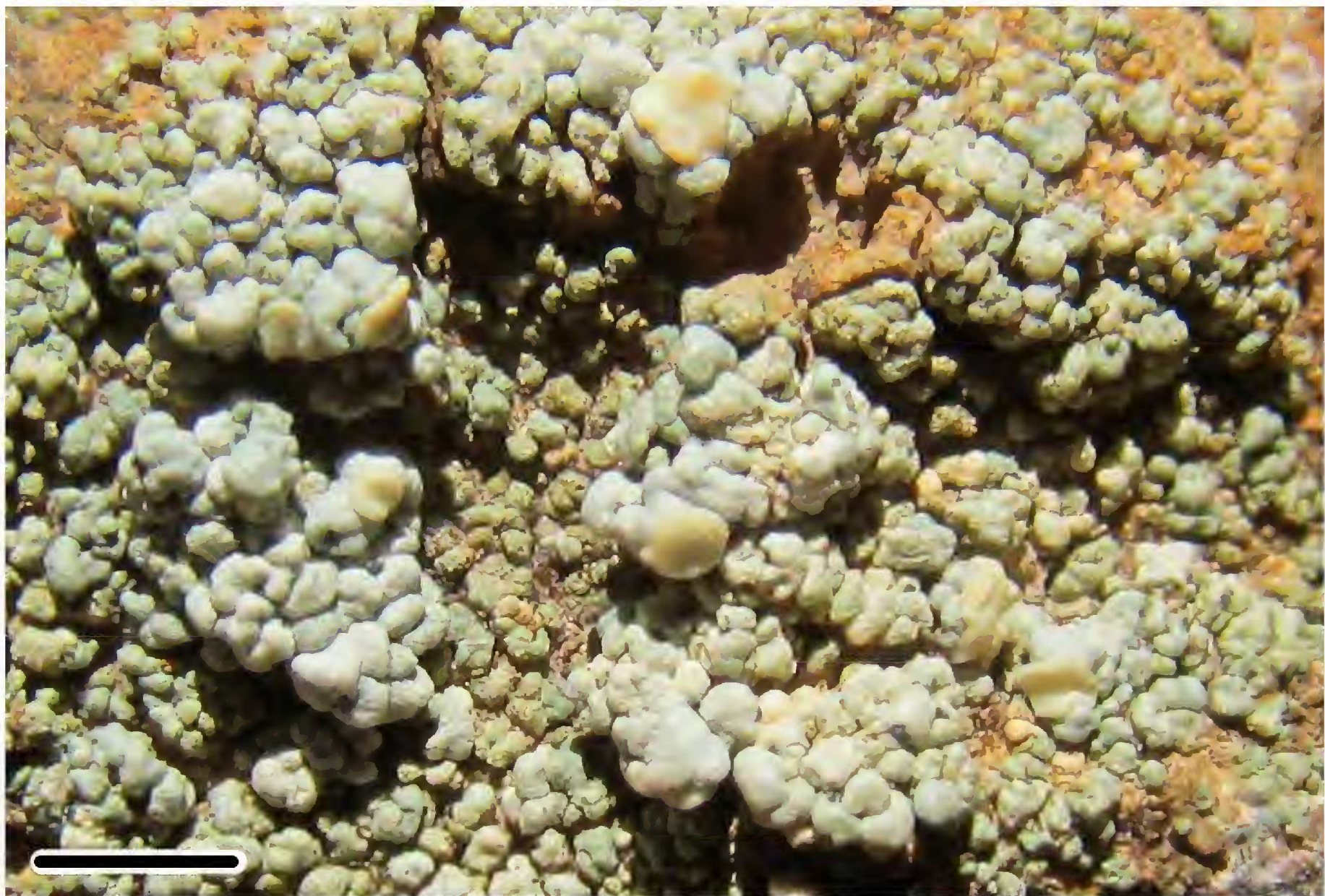
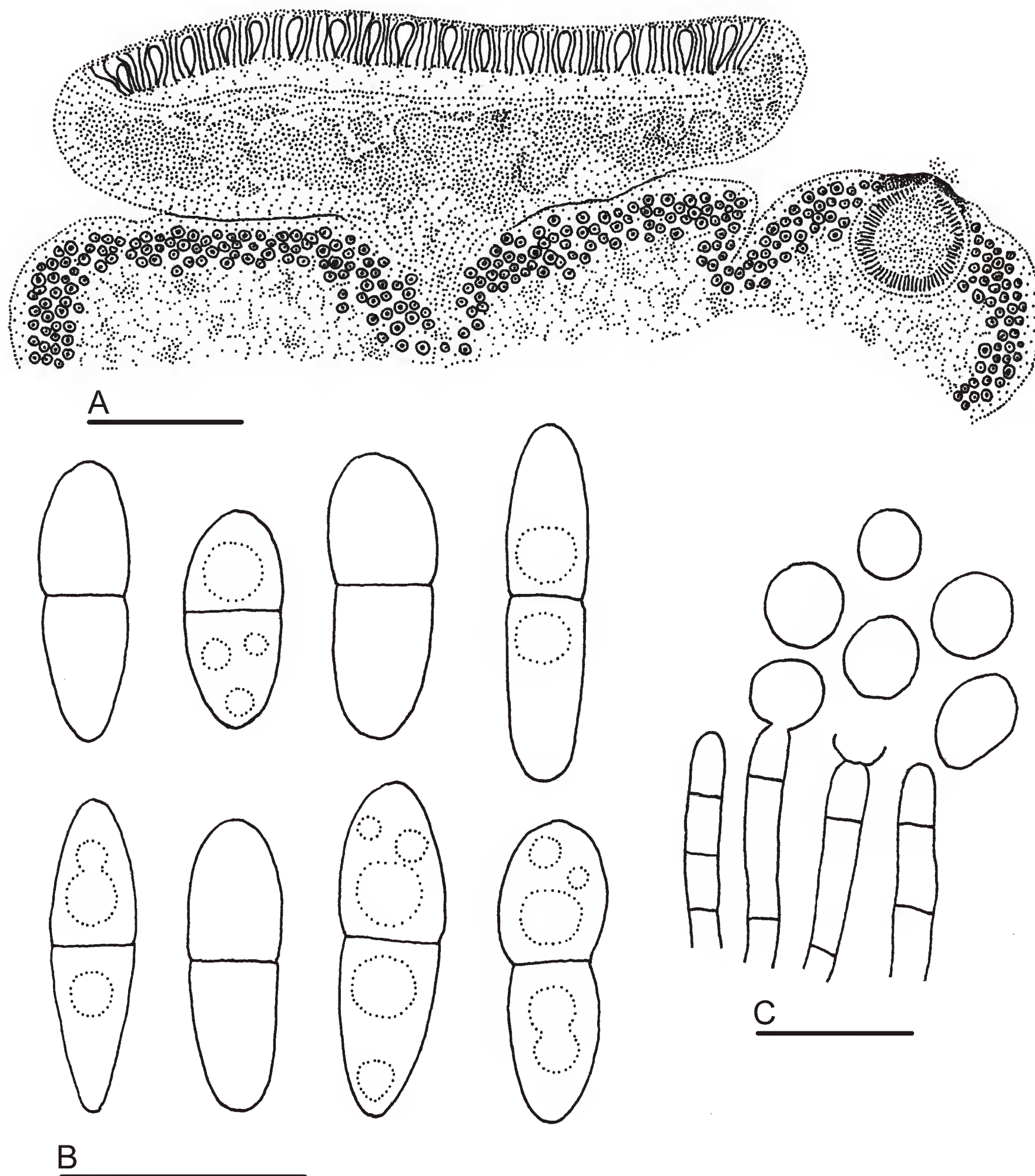


Fig 3. *Fellhanera robusta* (holotype). Scale bar = 2 mm.





**Fig 4.** *Fellhanera robusta* (holotype). A, Sectioned apothecium, pycnidium and adjacent thallus (semi-schematic); B, Ascospores; C, Conidiophores and conidia. Scale bars: A = 0.2 mm; B = 10 µm; C = 5 µm.

**3. *Menegazzia fortuita* Elix & P.M.McCarthy *sp. nov.***

MycoBank No.: MB 821990

**Diagnosis:** Distinguished from *M. aeneofusca* (Müll.Arg.) R.Sant. by the much larger ascospores ( $62\text{--}98 \times 37\text{--}65 \mu\text{m}$  vs  $44\text{--}52 \times 17\text{--}20 \mu\text{m}$ ) with thicker spore walls ( $7\text{--}13 \mu\text{m}$  thick vs *c.*  $3 \mu\text{m}$ ).

**Type:** Australia. New South Wales, Southern Tablelands, Morton National Park, trail to Pigeon House Mountain, 15 km W of Ulladulla,  $35^{\circ}21'S$ ,  $150^{\circ}16'E$ , alt. 450 m, on sandstone rock on open rocky ridge, *J.A. Elix 30403*, 30 Nov 2000; holo: CANB.



*Thallus* saxicolous, foliose, adnate to loosely adnate, up to 30 mm wide and 50  $\mu\text{m}$  thick on sides of the hollow lobes, forming rosettes or irregularly spreading. *Lobes* hollow, sublinear-elongate, very fragile, contiguous or imbricate for the most part, more rarely discrete, overlapping in older parts of the thallus, subdichotomously to subirregularly branched, narrow, 0.5–1.5 mm wide; apices sometimes subpalmate. *Upper surface* off-white to grey-brown or blackened, convex, dull to glossy, lacking soredia and isidia, rarely lobulate towards the centre; lobules knob-like, 0.1–0.25 mm wide, up to 0.3 mm long, perforate or not. Perforations laminal, scattered, flush with the surface, oval or rounded, gaping, with white medullary flecks at margin, 0.1–0.6 mm wide. *Medulla* white in the upper part of the internal cavity, darkening with age, lower side of cavity black. *Lower surface* black, brown at the apices, glossy, coarsely wrinkled to irregularly verrucose, the lower cortex in direct contact with the substratum, lacking anchoring hyphae, rhizines or haptera. *Upper cortex* c. 10  $\mu\text{m}$  thick, in surface view the cells interlocking and resembling jig-saw pieces, hyaline (in pale grey lobes) to medium brown (in brown lobes), thick-walled, 5–8(–10)  $\mu\text{m}$ ; lower cortex similar, but the cells greyish black to brown-black. *Algae* scattered beneath the upper cortex, or in clusters, or forming a diffuse layer to c. 25  $\mu\text{m}$  thick; cells chlorococcoid, globose, 6–17  $\mu\text{m}$  wide. *Medulla* poorly defined, the loose hyphae long-celled, 3–6  $\mu\text{m}$  thick and hyaline below the upper surface, similar but greyish black above the lower cortex. *Apothecia* very sparse, solitary, lecanorine, sessile to subpedicellate, rounded, 0.8–2 mm diam. [ $n = 5$ ]; disc imperforate, weakly concave to plane, pale brown to brown; margin thick, entire, rarely weakly crenulate. *Thalline excipulum* 120–150  $\mu\text{m}$  thick; cortex paraplectenchymatous, 10–18(–25)  $\mu\text{m}$  thick. *Proper excipulum* lacking. *Hypothecium* 70–90  $\mu\text{m}$  thick, not interspersed with granules or oil globules; upper half pale orange-brown, the pigment become considerably paler and yellowish in K, N–, consisting of elongate, thick-walled periclinial cells that give way to much thicker-walled, variously orientated cells in the chondroid, hyaline lower half. *Epihymenium* 20–35  $\mu\text{m}$  thick, concolorous with the upper hypothecium, the pigment exhibiting similar reactions to K and N. *Hymenium* 180–230  $\mu\text{m}$  thick, not interspersed, IKI+ blue. *Paraphyses* conglutinate in the hymenial gel, anastomosing, long-celled, 1–1.5  $\mu\text{m}$  thick; apical cells pale to medium brown, globose, scarcely swollen in water and (1.5–)2(–2.5)  $\mu\text{m}$  wide, 2.5–4  $\mu\text{m}$  wide in K. *Asci* clavate to broadly cylindrical, 2-spored, 135–205  $\times$  48–72  $\mu\text{m}$  [ $n = 25$ ]. *Ascospores* colourless, simple, one above the other in the ascus or slightly obliquely arranged, narrowly to broadly ellipsoid, ovoid to subglobose, with rounded ends, the contents clear to, commonly, vacuolate and granulose, (62–)77(–98)  $\times$  (37–)50(–65)  $\mu\text{m}$  [ $n = 50$ ]; spore wall smooth, (7–)10(–13)  $\mu\text{m}$  thick. *Pycnidia* scattered, immersed, globose; conidia bacilliform to weakly fusiform, 4.5–7.5  $\times$  0.7–1  $\mu\text{m}$ . **Fig. 6.**



**Fig 5.** Cliff at Callala Bay, New South Wales, the type locality of *Fellhanera robusta* and *Ramboldia curvispora*.





Fig 6. *Menegazzia fortuita* (holotype). Scale bar = 1 mm.

**Chemistry:** Cortex K+ yellow; medulla K+ yellow, C–, KC–; P+ yellow-orange; containing atranorin (minor), stictic acid (major), constictic acid (minor), peristictic acid (trace), cryptostictic acid (trace), menegazziaic acid (trace).

**Relationships:** The most characteristic features of this new saxicolous species are the very fragile, narrow, lobes, the lack of vegetative propagules, the 2-spored asci and very large ascospores, and the presence of the stictic acid chemosyndrome in the medulla. The commonly blackened lobes of *M. fortuita* could be confused with those of *M. aeneofusca*, another saxicolous species with bisporous asci which contains the stictic acid chemosyndrome. *Menegazzia aeneofusca* differs in having somewhat broader lobes (to 2 mm wide) and significantly smaller ascospores,  $44\text{--}52 \times 17\text{--}20 \mu\text{m}$  with walls c.  $3 \mu\text{m}$  thick (James and Galloway 1992, Kantvilas 2012). Similarly, the very common Australian species *M. platytrema* (Müll.Arg.) R.Sant. can also grow on rocks, has 2-spored asci and identical chemistry. However, it can be distinguished by the broader, robust lobes (1–4 mm wide) with a pale grey to grey upper surface, and by the smaller ascospores,  $45\text{--}57 \times 25\text{--}32 \mu\text{m}$ , with walls  $2.5\text{--}3.5 \mu\text{m}$  thick (James and Galloway 1992, Kantvilas 2012).

**Etymology:** The epithet *fortuita* alludes to an unplanned field-stop that led to the discovery of the most recent collection which, fortuitously, helped to resolve the identity of several older, unnamed specimens.

**Distribution and habitat:** At present, *M. fortuita* is known from four localities in Morton National Park in south-eastern New South Wales where it occurs on Hawkesbury sandstone rocks in open *Eucalyptus* woodland. Common, associated species included *Buellia homophylla* (C.Knight) Zahlbr., *B. procellarum* A.Massal., *B. stellulata* (Taylor) Mudd var. *stellulata*, *Lecanora pseudistera* Nyl., *Pertusaria subventosa* Malme var. *subventosa*, *P. xanthoplaca* Müll.Arg., *Ramboldia petraeoides* (Nyl. ex C.Bab. & Mitt.) Kantvilas & Elix, *Xanthoparmelia antleriformis* (Elix) Elix & J.Johnst., *X. streimannii* (Elix & P.M.Armstr.) Elix & J.Johnst. and *X. imitatricoides* (Elix) O.Blanco, A.Crespo, Elix, D.Hawksw. & Lumbsch.

**Additional specimens examined:** NEW SOUTH WALES: Southern Tablelands, Morton National Park, slopes of Pigeon House Mountain, 19 km W of Ulladulla,  $35^{\circ}21'S$ ,  $150^{\circ}16'E$ , alt. 500 m, on shaded face of large sandstone tor, D. Verdon 3123, 29 Sep 1977 (CANB); Morton National Park, 8 km NE of Nerriga,  $35^{\circ}07'S$ ,  $150^{\circ}08'E$ , alt. 750 m, on sheltered sandstone ledge in open *Eucalyptus* woodland, J.A. Elix 5078, 31 Dec 1978 (CANB); loc. id., J.A. Elix 10170, 1 May 1982 (CANB); loc. id., J.A. Elix 11379 & J. Johnston, 6 Oct 1983 (CANB); loc. id., J.A. Elix 30459, 29 Mar 2001 (CANB); type locality, on exposed sandstone rocks in dry sclerophyll forest, J.A. Elix 21308 & H. Streimann, 2 Dec 1986 (CANB); Morton National Park, Tianjara Falls, 33 km NNW of Ulladulla,  $35^{\circ}06'35''S$ ,  $150^{\circ}19'53''E$ , alt. 390 m, on sheltered sandstone ledge in open *Eucalyptus* woodland, P.M. McCarthy 4569, 19 Apr 2017 (CANB).



#### 4. *Ramboldia curvispora* P.M.McCarthy & Elix *sp. nov.*

MycoBank No.: MB 821991

**Diagnosis:** Distinguished from *R. blastidiata* Kantvilas & Elix, by the thallus lacking lichen substances (norstictic acid present in the latter), by the blastidia that do not abrade and become paler and sorediate, a hymenium that is 45–60 µm thick (30–45 µm thick in *R. blastidiata*), and longer ascospores (10–17 µm and curved vs 8.5–12 µm and straight).

**Type:** Australia. New South Wales, South Coast, Jervis Bay, Callala Bay, 0.5 km W of Callala Point, 35°00'22"S, 150°43'07"E, alt. 0.5–2 m, on unstable, vertical shale cliff receiving sea spray and soil runoff from above, *P.M. McCarthy* 4618, 19 Apr 2017; holo: CANB.

*Thallus* crustose, epilithic, forming colonies to 5 (–10) cm wide, pale to dark greyish green, or yellow-brown to olive-brown, (0.08–)0.15–0.8(–1.1) mm thick, richly rimose to areolate. *Areoles* contiguous, angular and ± isodiametric to irregular in shape, 0.2–1.2(–2) mm in maximum extent, plane to irregularly convex or almost bullate-substipitate, occasionally pseudolobate at the margin; surface irregularly rugulose to verruculose, commonly densely blastidiate, lacking soredia and isidia; blastidia numerous, globose or irregular, scattered, clustered or short-catenate, 50–70 µm wide. *Cortex* lacking and the thallus usually with an uppermost, 10–15 µm thick alga-free zone, or patchily corticate and with a layer of brown, rounded, thick-walled cells (4–)5–7(–8) µm diam. *Algal layer* continuous, discrete and 50–150(–250) µm thick; cells green, chlorococcoid, often rather thick-walled, 10–16(–22) µm diam.; interstitial hyphae short-celled, 2–3 µm wide. *Medulla* not well delimited, most of the thallus below the algal layer being obscured by minute rock fragments and crystals, not containing calcium oxalate ( $\text{H}_2\text{SO}_4$ –), I–; hyphae loose, long-celled, thin-walled, 2.5–5 µm wide. *Prothallus* not apparent. *Apothecia* very numerous, adnate to subsessile, occasionally sessile and constricted at the base, lecideine to biatorine, solitary and rounded to rather irregular, (0.21–)0.45(–0.74) mm diam. [ $n = 160$ ], or in proliferating clusters of 3–6(–8); margin distinct and persistent, but not prominent, concolorous with the disc, dull to slightly glossy, entire, 60–100 µm thick in surface view, or becoming excluded; disc initially plane, usually becoming moderately or strongly convex, dark brown or olive-black to blackish, smooth, dull to slightly glossy, epruinose. *Thalline excipulum* absent. *Proper excipulum* well-developed, 40–70(–100) µm thick laterally in section, 25–50(–80) µm thick at the base, ± colourless except for a 10–15(–20) µm thick, medium to dark greenish brown lateral rim (K–, N+ red-brown to purple-brown); either 1) broadly annular and with a narrow central gap, or 2) cupular and with an irregular, undulate basal edge, or the excipulum base forming the outer edge of a broad, blunt ‘stipe’ up to 300 µm wide and 350 µm deep; excipular anatomy hyphal, not interspersed with crystals; hyphae radiating laterally towards the margin and vertically downwards basally, dichotomously dividing and with numerous anastomoses, long-celled, 2–3.5 µm wide; outermost hyphae 3.5–7 µm wide, with lumina c. 1 µm wide. *Epithymenium* 5–10(–15) µm thick, blue-green, K+ blue, N+ purple, the pigment sometimes diffusing down 15–25 µm into the hymenium. *Hypothecium* colourless, not interspersed with granules or oil globules, 30–50(–70) µm laterally, 60–100 µm thick in the centre above an annular excipulum, up to 270 µm deep when a basal ‘stipe’ has formed, loosely paraplectenchymatous, the hyphae 1.5–2.5 µm wide, K–, patchily I+ blue, N–. *Hymenium* 45–60 µm thick, not interspersed, N–, K–; hymenial gel I–; *paraphyses* tightly conglutinate in water, only a little looser in K, unbranched for most of their length, often sparingly branched below the apices, with occasional anastomoses, long-celled, 1–2 µm thick; apices not or only very slightly swollen (clavate and up to 2.5 µm wide), not pigmented. *Asci* narrowly to broadly clavate, 8-spored, 37–48 × 14–20 µm [ $n = 40$ ], *Lecanora*-type; tholus with a strongly amyloid lateral part, a non-amyloid broadly diverging axial mass with a thick, non-amyloid cap above and a weakly amyloid, outer layer; ocular chamber lacking. *Ascospores* colourless, simple, or with a median pseudoseptum, occasionally 1-septate at maturity, narrowly ellipsoid to oblong-ellipsoid or obovoid, usually bent or strongly curved and often more rounded distally and rather acute at the proximal end, irregularly biserial in the ascus, or massed so that the curved spores almost interlock, (10–)14(–17) × (3.5–)4.5(–5.5) µm [ $n = 131$ ], thin-walled, lacking a perispore, usually not constricted in 1-septate spores; contents granular to minutely guttulate, occasionally clear. *Pycnidia* moderately numerous, almost completely immersed the thallus, rounded to pyriform in section, 60–100(–120) µm wide; apex blackish, low-convex, dark brown in section; lateral and basal walls dark brown, 6–10 µm thick; conidiogenous layer simple to somewhat convoluted, the conidiophores unbranched, 6–14 µm long, c. 0.8 µm thick; conidia elongate-bacilliform to filiform, (5–)7–10(–12) × 0.5–1(–1.2) µm. **Figs 7, 8.**

**Chemistry:** Thallus K–, C–, KC–, PD–, UV–; no substances detected by TLC.



**Relationships:** The new species is characterized by the thick, rather dark and well-developed, areolate thallus that becomes blastidiolate and lacks lichen substances, mostly adnate to sessile, medium-sized, blackish apothecia with a thick, mainly hyaline proper excipulum that can be annular or cupulate, a blue-green to brownish green, K+ blue, N+ purple epihymenium, commonly curved ascospores and long-bacilliform to filiform conidia. Superficially, it resembles some specimens of *R. blastidiata*, but that species has blastidia that often abrade and become paler and soresolate, as well as shorter, straight ascospores, 8.5–12  $\mu\text{m}$  long, longer conidia (14–17  $\mu\text{m}$  long), a thinner hypothecium (30–45  $\mu\text{m}$  thick), a red-brown, K+ olive-brown, N– epihymenium and a thallus containing norstictic acid (Kantvilas and Elix 2007). While the epihymenial reactions of *R. curvispora* differ from those of all known saxicolous species of the genus (Elix 2009, Elix and McCarthy 2017), they resemble those observed in *R. elabens* (Fr.) Kantvilas & Elix from the Northern Hemisphere. However, the latter has a white to grey, verrucose or verruculose, corticolous thallus containing atranorin and fumarprotocetraric acid, glossy black apothecia, ascospores 8–10(–12)  $\times$  3–4  $\mu\text{m}$  and arcuate-filiform conidia 11–35  $\times$  0.5–1  $\mu\text{m}$  (Ryan et al. 2004).

**Etymology:** The specific epithet refers to the distinctively curved ascospores of the new species.

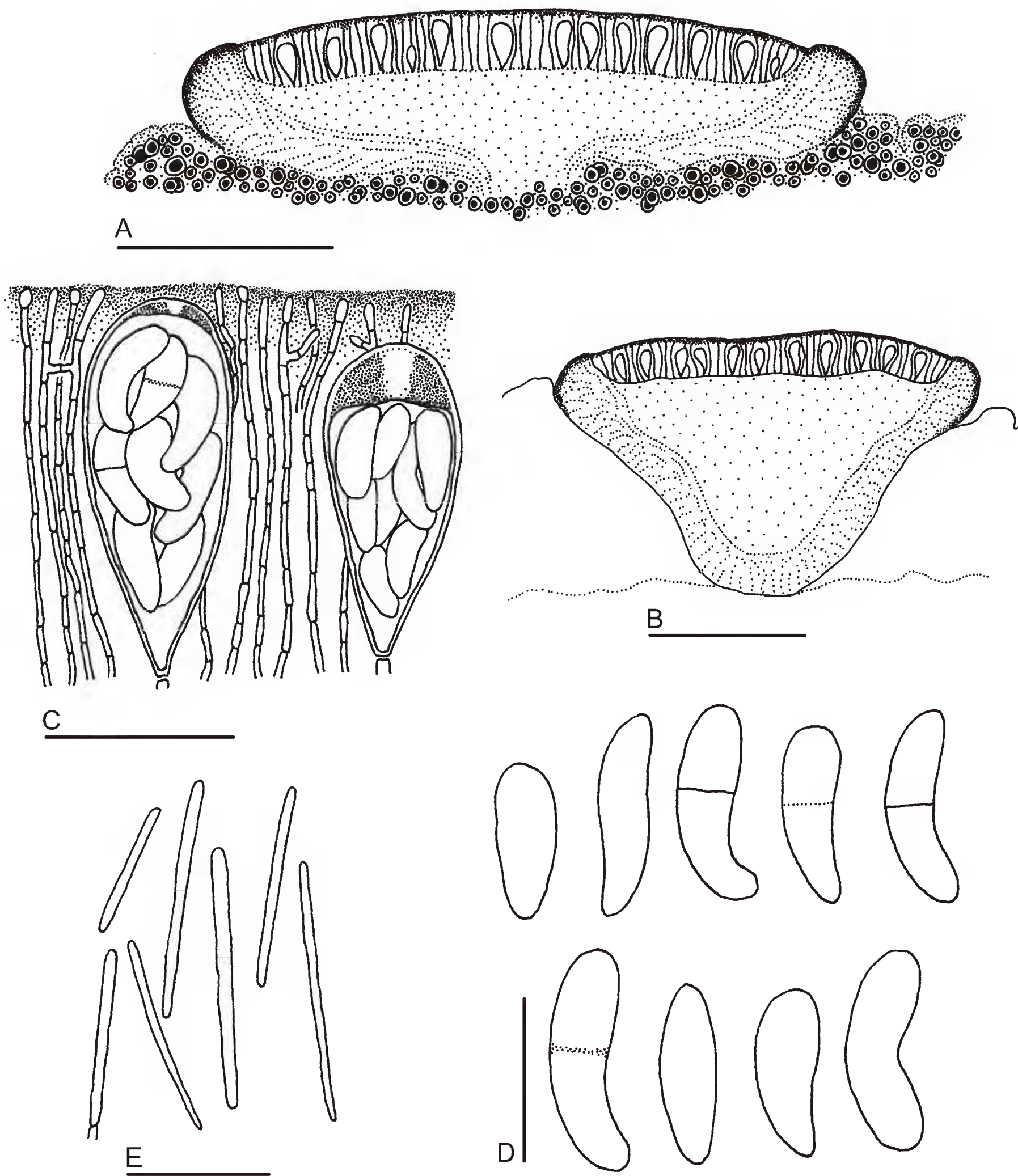
**Distribution and habitat:** *Ramboldia curvispora* is known from hard and soft siliceous rocks on and immediately above seashores on the south coast of New South Wales, and in the adjacent tablelands. See *Fellhanera robusta* (above) for a brief account of their shared type locality and associated lichen flora.

**Additional specimens examined:** NEW SOUTH WALES: South Coast, Tomakin, Barlings Beach, 35°49'49"S, 150°12'20"E, alt. 1–3 m, on sheltered shale cliff on the foreshore, P.M. McCarthy 4546, 19 Nov 2016 (CANB); type locality, J.A. Elix 46383, 23 May 2017 (CANB); *loc. id.*, P.M. McCarthy 4607, 23 May 2017 (CANB); Crookhaven Heads, 16 km ESE of Nowra, S of lighthouse, 34°54'07"S, 150°46'06"E, alt. c. 2 m, on hard, siliceous rocks above the seashore, P.M. McCarthy 4573, 24 May 2017 (CANB), Boat Harbour, Gerringong, 34°44'59"S, 150°49'55"E, alt. 1–3 m, on shaded sandstone rocks along foreshore, P.M. McCarthy 4605, 24 May 2017 (CANB); Southern Tablelands, Morton National Park, Tianjara Falls, 33 km NNW of Ulladulla, 35°06'35"S, 150°19'53"E, alt. 390 m, in shaded cleft of sandstone boulder in open *Eucalyptus* forest, J.A. Elix 46381, 23 May 2017 (CANB); *loc. id.*, P.M. McCarthy 4587, 23 May 2017 (CANB).



Fig. 7. *Ramboldia curvispora* (holotype). Scale bar = 2 mm.





**Fig. 8.** *Ramboldia curvispora* (holotype). A, Sectioned apothecium with a broad, annular excipulum, and adjacent thallus (semi-schematic); B, Sectioned apothecium with a cupular excipulum around a penetrating 'stipe'; C, Mature and submature asci stained with Lugol's iodine after pre-treatment with K, and paraphyses; D, Ascospores; E, Conidia. Scale bars: A, B = 0.2 mm; C = 20 µm; D = 10 µm; E = 5 µm.

**5. *Sarcogyne maritima* P.M.McCarthy & Elix *sp. nov.***

MycoBank No.: MB 821992

**Diagnosis:** Distinguished from the montane, silicolous *S. sekikaica* P.M.McCarthy & Elix by the thallus lacking lichen substances (the latter contains sekikaic acid), the epruinose apothecia (usually white-pruinose in *S. sekikaica*) and smaller ascospores ( $2.5\text{--}6 \times 2\text{--}3$  µm vs  $6\text{--}9.5 \times 3\text{--}5$  µm) that are more numerous in the asci (c. 100–150 vs c. 40–80 per ascus).



**Type:** Australia, New South Wales, South Coast, c. 2.5 km N of Gerringong, Werri Beach, N headland, 34°43'42"S, 150°50'15"E, alt. 2 m, on sheltered, hard sandstone above the seashore, P.M. McCarthy 4582, 24 May 2017; holotype: CANB.

*Thallus* crustose, epilithic, effuse to  $\pm$  determinate, predominantly areolate, rimose towards the margin, 0.08–0.2(–0.25) mm thick, forming colonies to 2.5 cm wide, dull pale greenish grey to pale sandy brown. *Areoles* tightly contiguous, angular and  $\pm$  isodiametric or irregular in shape, 0.4–1 mm in maximum extent, slightly concave to plane in the centre and with a smooth to minutely undulate surface; margins prominent, raised, usually entire, occasionally fissured, to 0.1(–0.15) mm wide; areoles of fertile thalli smaller, more irregular and often contorted. *Cortex* obscurely paraplectenchymatous, the cells subglobose, hyaline, thin-walled and 4–7  $\mu$ m wide, or the thallus with a  $\pm$  amorphous, alga-free, uppermost layer 15–25  $\mu$ m thick. *Algal layer* 60–100(–150)  $\mu$ m thick, continuous or broken by 20–40  $\mu$ m wide columns of vertically orientated, thin-walled, short-celled hyphae; algal cells green, chlorococcoid, globose, 6–14  $\mu$ m wide; interstitial mycobiont cells  $\pm$  rounded, 1.5–2.5(–3)  $\mu$ m wide. *Medulla* poorly defined, heavily impregnated with minute rock fragments and crystals,  $\text{H}_2\text{SO}_4$ –; hyphae short-celled, 2–4  $\mu$ m wide. *Prothallus* not apparent. *Apothecia* moderately numerous, lecideine, solitary, initially innate and 1 per areole, becoming adnate, usually solitary, rounded, broadly ellipsoid or more irregular in shape, (0.23–)0.40(–0.55) mm diam. [ $n = 53$ ]; disc slightly concave to plane, smooth, epruinose, dull greenish black, the colour unchanged when wetted; margin somewhat prominent, 50–70(–80)  $\mu$ m thick, entire, smooth, dull to slightly glossy, persistent at maturity, usually a little or markedly paler than the disc. *Proper excipulum* non-carbonized, annular, laterally with or without an outer, 5–10  $\mu$ m thick necral layer overlaying a dark brown zone c. 30  $\mu$ m thick in section, radiating-prosoplectenchymatous, the hyphae tightly conglomerate, elongate, anastomosing, thick-walled, with cells 2–3  $\mu$ m wide, the outermost cells ellipsoid to globose, (4–)6–8(–10)  $\mu$ m wide; excipulum base colourless, 15–20  $\mu$ m thick, of long-celled, thin-walled, periclinal hyphae with cells 6–10  $\times$  2–2.5  $\mu$ m; the cells of the proper excipulum and hypothecium becoming narrower and more elongate when penetrating the thallus as a blunt stipe to 100  $\mu$ m wide. *Hypothecium* hyaline, 50–75  $\mu$ m thick in the centre of the apothecium, not inspersed, K–, N–, I–, of loose, short-celled, variously orientated hyphae 1.5–2  $\mu$ m wide. *Hymenium* 80–100  $\mu$ m thick, not inspersed with granules or oil droplets; hymenial gel I+ blue. *Epihymenium* medium to dark greenish brown, 8–15(–20)  $\mu$ m thick, K–, N+ pale brown. *Paraphyses* rather tightly conglomerate in water, loosening a little in K (except near the apices), unbranched below, sparingly branched in the epihymenium, long-celled, 0.8–1.2(–1.5)  $\mu$ m wide, some apical cells slightly thicker-walled, rounded, 2–3  $\mu$ m wide, lacking pigmentation. *Asci* broadly clavate to clavate-cylindrical or narrowly ellipsoidal, containing c. 100–150 ascospores, 55–80  $\times$  17–33  $\mu$ m [ $n = 20$ ], with an abrupt or more tapering stalk; apex rounded, with a thin to thick, uniformly but lightly amyloid tholus and an inconspicuous or distinct and broad, blunt ocular chamber. *Ascospores* colourless, simple, short-bacilliform or narrowly to broadly ellipsoid, occasionally shortly fusiform, with rounded or, occasionally, somewhat pointed ends, lacking a perispore, occasionally uni- or biguttulate, (2.5–)4(–5.5)  $\times$  (1.5–)2(–2.5)  $\mu$ m [ $n = 50$ ]. *Pycnidia* solitary, numerous, completely immersed in the thallus,  $\pm$  elongate-obpyriform to obclavate, to 150  $\mu$ m tall and up to 80  $\mu$ m wide, hyaline throughout; pycnidial wall paraplectenchymatous, c. 10  $\mu$ m thick, the cells 2.5–6  $\times$  2–3  $\mu$ m; conidiogenous layer simple or slightly convoluted; conodiophores unbranched, to 10–15  $\mu$ m long; conidia budding apically in moniliform series, narrowly to broadly ellipsoid or subglobose, or short-bacilliform to fusiform, 0.8–2  $\times$  0.5–1  $\mu$ m. **Figs 9, 10.**

**Chemistry:** Thallus K–, C–, KC–, PD–, UV–; no substances detected by TLC.

**Relationships:** *Sarcogyne*, with more than 40 accepted species, has a crustose thallus that is often immersed or semi-endolithic and frequently inconspicuous, reddish brown to black lecideine apothecia, a non-carbonized epihymenium, simple to sparingly branched paraphyses and, most distinctively, asci that produce 50–200 or more, simple ascospores (Clauzade and Roux 1985, Knudsen and Standley 2008, Fletcher and Hawksworth 2009). Species inhabit calcareous and siliceous rocks and soil mainly in temperate and semi-arid regions, especially in Europe, North Africa and North America. Recent studies of the Australian species have confirmed the occurrence of eight taxa, five of which are currently accepted as endemic (McCarthy and Kantvilas 2013, McCarthy and Elix 2014, 2017). *Sarcogyne maritima* is characterized by a suite of attributes, including its habitat (coastal, siliceous rock), an unequivocally epilithic and distinctively areolate thallus (the plane areoles having raised margins) lacking lichen substances, adnate, epruinose apothecia and ascospores 2.5–6  $\times$  2–3  $\mu$ m and c. 100–150 per ascus. The silicolous *S. sekikaica*, from the Central Tablelands of New South Wales, contains sekikaic acid, has white-pruinose apothecia with much larger and fewer ascospores in the asci (McCarthy and Elix 2014), while *S. iridana* P.M. McCarthy & Kantvilas, from sandstone in central Australia, has a very thin, diffuse whitish thallus and comparatively large and prominent apothecia (McCarthy and Kantvilas 2013). The widespread *S. hypophaea* (Nyl.) Arnold occurs on siliceous and calcareous rocks, has a very thin and inconspicuous thallus, and the apothecia have carbonized and jointed margins (Knudsen and Standley 2008; Fletcher and Hawksworth 2009; Knudsen et al. 2013), and the usually silicolous *S. similis* H. Magn. (North



America, the Mediterranean and southern Africa) has a predominantly endolithic thallus and apothecia 0.5–1(–2.1) mm wide, each with a thick, black margin (Knudsen and Standley 2007).

**Etymology:** The specific epithet refers to the discovery of the new species on coastal rocks.

**Distribution and habitat:** The new species is known only the type locality, viz. hard sandstone outcrops approximately 50 metres back from high water mark at Werri Beach, on the South Coast, New South Wales. Associated lichens included *Buellia cranwelliae* Zahlbr., *B. stellulata* (Taylor) Mudd var. *stellulata*, *Caloplaca* spp., *Catillaria* sp., *Diploschistes euganeus* (A.Massal.) J.Steiner, *Halecania subsquamosa* (Müll.Arg.) van den Boom & H.Mayrhofer, *Pertusaria melanospora* var. *sorediata* Elix & A.W.Archer, *P. subventosa* Malme var. *subventosa*, *P. xanthoplaca* Müll.Arg., *Rinodinella fertilis* (Körb.) Elix var. *fertilis* and *Solenopsora vulturiensis* A.Massal.

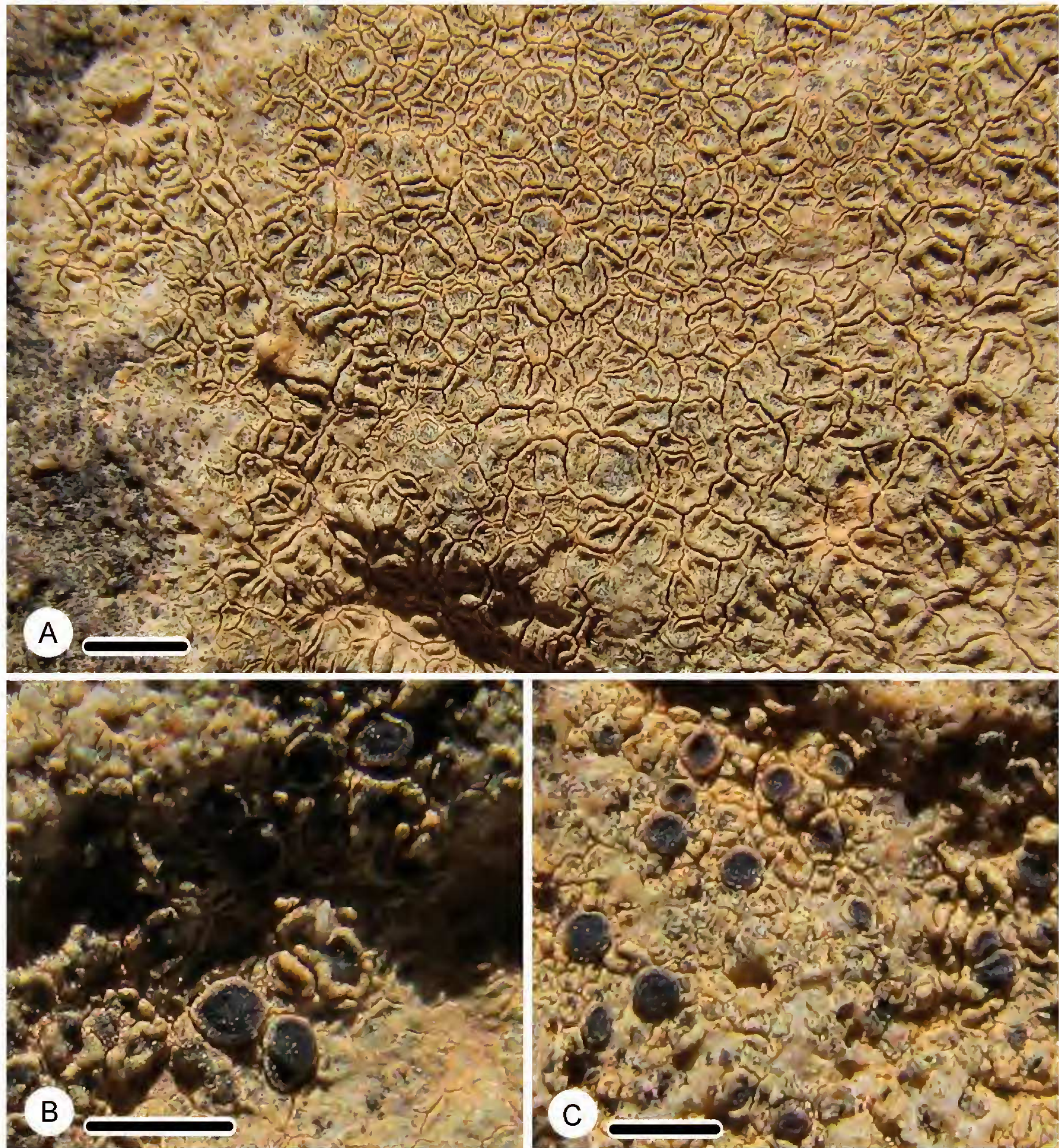
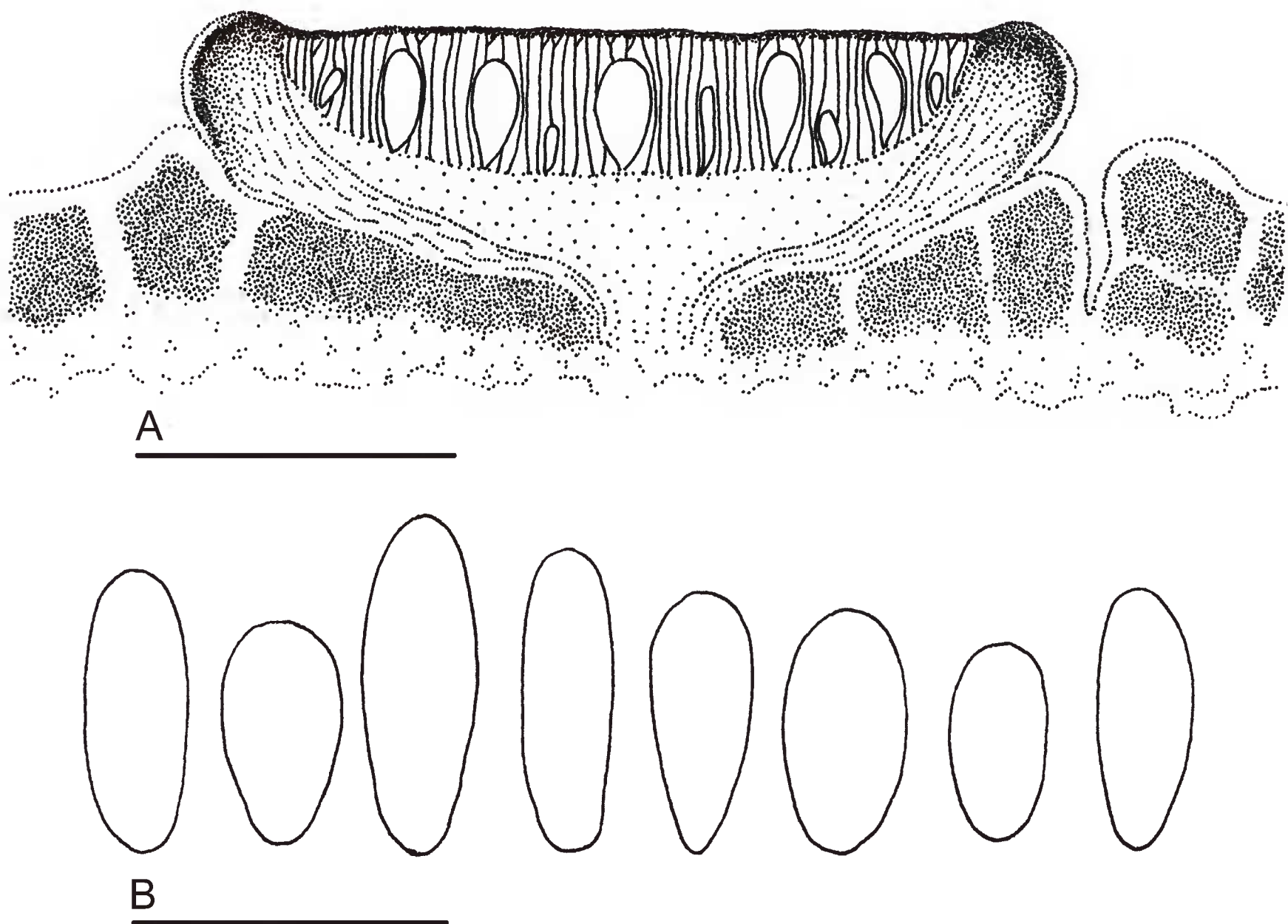


Fig. 9. *Sarcogyne maritima* (holotype). A, Sterile thallus; B, C, Fertile thalli. Scale bars = 1 mm.





**Fig. 10.** *Sarcogyne maritima* (holotype). A, Sectioned apothecium and adjacent thallus (semi-schematic); B, Ascospores. Scale bars: A = 0.2 mm; B = 5  $\mu$ m.

### New Record

***Arthonia lapidicola*** (Taylor) Branth & Rostrup, *Botanisk Tidsskrift* 3: 245 (1869)

Basionym: *Lecidea lapidicola* Taylor, in J.T.Mackay, *Flora Hibernica* 2: 124 (1836).

Type: Cappashmore [Cappaghmore] Bridge, County Kerry, Ireland, *T.Taylor s.n.* (holotype: BM 000762560, *n.v.*)

*Thallus* crustose, epilithic, effuse, continuous to rimose or areolate, smooth to minutely and irregularly uneven, dull pale yellowish green, or pale to medium greenish grey or medium olive-green, (30–)50–80(–100)  $\mu$ m thick, ecorticate; areoles plane, angular, irregular in outline, to 0.6 mm wide. *Algae* green, globose, not trentepohlioid, 7–16(–23)  $\mu$ m diam.; interstitial mycobiont hyphae short-celled, 1.5–3  $\mu$ m wide. *Prothallus* not apparent. *Ascomata* numerous, resembling apothecia, outwardly immarginate at all stages of development, solitary or merging or proliferating into groups of up to 6, adnate, rounded, broadly ellipsoid or more irregular in outline, (0.18–)0.36(–0.57) mm in maximum extent [ $n = 100$ ]; disc dull black, usually moderately to strongly convex, occasionally hemispherical, rarely plane, smooth to minutely uneven. *Proper excipulum* absent or rudimentary and visible only as a very narrow (5–9  $\mu$ m), brown-black zone at the basal ascomatal margin, largely contiguous with the hypothecium. *Hypothecium* dark brown to dark reddish brown, or with a greenish tint, with paler and darker patches and streaks in thin section, 60–100(–120)  $\mu$ m thick in the centre of the ascoma, K–, N+ more reddish. *Hymenium* predominantly hyaline, but with brownish streaks of pigment extending down from the epihymenium and up from the hypothecium, 50–70  $\mu$ m thick, interspersed with granules; hymenial gel IKI+ pale greyish blue. *Epihymenium* dark brownish green, 10–20  $\mu$ m thick, K–, N+ reddish brown. *Paraphyses* with abundant anastomoses, forming a compact reticulum about the asci, 1–1.5(–2)  $\mu$ m wide, short-celled; apices swollen, 2–2.5(–4)  $\mu$ m wide, rounded, with thick, dark brown outer walls. *Asci* 8-spored, broadly clavate,



37–50 × 15–22 µm [ $n = 10$ ]; stalk with an abruptly swollen base 4–6 µm wide; apex rounded, with a thick, weakly amyloid tholus when submature (usually scarcely apparent at maturity) and a low and inconspicuous or taller and conical ocular chamber with a more intensely amyloid basal ring. *Ascospores* colourless, irregularly massed in the ascus, 1-septate, mostly slipper-shaped and with a gradual median narrowing, less commonly abruptly constricted at the septum, most with rounded ends, locules similar in size and shape, or the distal one longer and broader, thin-walled, lacking a perispore, (11–)14(–19) × (4.5–)5.5(–8) µm [ $n = 70$ ]; contents densely granulose and/or small-guttulate. *Pycnidia* solitary, numerous, usually semi-immersed, brownish black above and hemispherical to subconical, medially brownish in section, hyaline below, 50–70(–100) µm wide; conidiophores 8–15 × 1 µm; conidia narrowly ellipsoid to short-fusiform or bacilliform, 3–5 × (0.5–)1–1.5 µm. **Figs 11, 12.**

**Chemistry:** Thallus K–, C–, KC–, PD–, UV–; no substances detected by TLC.

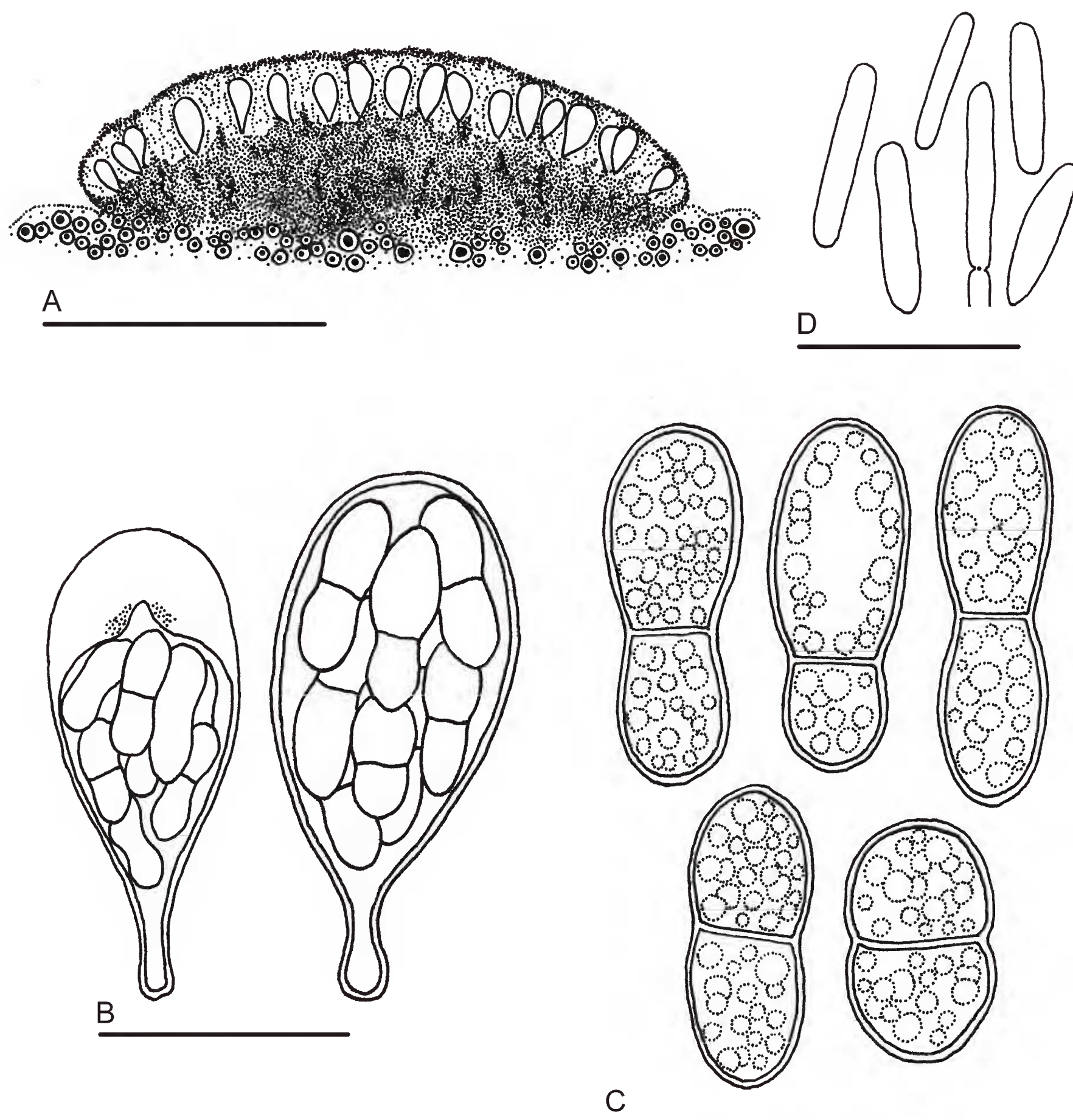
**Notes:** *Arthonia* is a cosmopolitan genus of up to 300 species, including lichenized taxa on all substrata, as well as lichenicolous parasites and other lichen-associated entities. However, only a small minority of species combine a saxicolous existence with a photobiont that is a unicellular green alga rather than trentepohlioid filaments. They include *A. lapidicola*, which exhibits a distinctive combination of small, blackish apothecia on a thin and rather nondescript thallus, a thick, dark brown hypothecium, mostly soleiform, 1-septate ascospores and bacilliform conidia. This lichen is known mainly from limestone, mortar and other base-rich rocks in boreal and temperate Eurasia and North America, North Africa, Macaronesia and New Zealand (Clauzade and Roux 1985, Thompson 1997, Galloway 2007, Coppins and Aptroot 2009). It has also been recorded from schist in the subantarctic South Orkney Islands, although with an anomalous, hyaline to pale brown hypothecium and comparatively large ascospores (Øvstedal and Lewis Smith 2001). *Arthonia lapidicola* is reported here for the first time from Australia, from a sheltered shale cliff on a seashore in southern New South Wales, and while its siliceous substratum is unusual, it agrees well with previous accounts of the species in its morphological and chemical attributes.

**Specimens examined:** NEW SOUTH WALES: South Coast, Jervis Bay, Callala Bay, 0.5 km W of Callala Point, 35°00'22"S, 150°43'07"E, alt. 0.5–2 m, on vertical shale cliff receiving sea spray and soil runoff from above, J.A. Elix 46454, 23 May 2017 (CANB); *loc. id.*, P.M. McCarthy 4629, 19 Apr 2017 (CANB).



**Fig. 11.** *Arthonia lapidicola* (J.A.Elix 46454). Two thalli. Scale bars: 1 mm.





**Fig. 12.** *Arthonia lapidicola* (J.A.Elix 46454). A, Sectioned ascoma and adjacent thallus (semi-schematic); B, Mature and submature asci in Lugol's iodine after pre-treatment with K; C, Ascospores; D, Conidia. Scale bars: A = 0.2 mm; B = 20 µm; C = 10 µm; D = 5 µm.

### References

- Aptroot A, Sérusiaux E, Edwards B, Coppins BJ (2009) *Fellhanera* Vězda (1986). Pp. 398–401 in Smith CW, Aptroot A, Coppins BJ, Fletcher A, Gilbert OL, James PW and Wolseley PA (eds), *The Lichens of Great Britain and Ireland*. (British Lichen Society, London)
- Clauzade G, Roux C (1985) Likenoj de Okcidenta Eŭropo. Ilustrita Determinlibro. *Bulletin de la Société Botanique du Centre-Ouest*, Nouvelle Série, Numéro Spécial 7: 1–893.
- Coppins BJ, Aptroot A (2009) *Arthonia* Ach. (1806). Pp. 153–171 in Smith CW, Aptroot A, Coppins BJ, Fletcher A, Gilbert OL, James PW and Wolseley PA (eds), *The Lichens of Great Britain and Ireland*. (British Lichen Society, London)
- Elix JA (2009) *Ramboldia*. *Flora of Australia* 57: 19–31.
- Elix JA (2014) *A Catalogue of Standardized Thin-Layer Chromatographic Data and Biosynthetic Relationships for Lichen Substances*, 3rd edn. Published by the author: Canberra.



- Elix JA, McCarthy PM (2017) Six new lichen species (Ascomycota) from Australia. *Telopea* 20: 147–163. <http://dx.doi.org/10.7751/telopea11598>
- Elix JA, McCarthy PM (2018) Ten new lichen species (Ascomycota) from Australia. *Australasian Lichenology* 82: *in press*.
- Elix JA, Kantvilas G, McCarthy PM (2017) Thirteen new species and a key to buellioid lichens (Caliciaceae, Ascomycota) in Australia. *Australasian Lichenology* 81: 26–67.
- Fletcher A, Coppins BJ (2009) *Catillaria* A.Massal. (1852). Pp. 282–288 in Smith CW, Aptroot A, Coppins BJ, Fletcher A, Gilbert OL, James PW and Wolseley PA (eds), *The Lichens of Great Britain and Ireland*. (British Lichen Society, London)
- Fletcher A, Hawksworth DL (2009) *Sarcogyne* Flot. (1851). Pp. 829–830 in Smith CW, Aptroot A, Coppins BJ, Fletcher A, Gilbert OL, James PW and Wolseley PA (eds), *The Lichens of Great Britain and Ireland*. (British Lichen Society, London)
- Fryday AM (2004) New species and records of lichenized fungi from Campbell Island and the Auckland Islands, New Zealand. *Bibliotheca Lichenologica* 88: 127–146.
- Fryday AM, Coppins BJ (1996) Three new species in the Catillariaceae from the central highlands of Scotland. *Lichenologist* 28: 507–512. <https://doi.org/10.1017/S0024282996000710>
- Galloway DJ (2007) *Flora of New Zealand Lichens*. Revised second edition. Manaaki Whenua Press: Lincoln.
- Hafellner J (1984) Studien in Richtung einer natürlicheren Gliederung der Sammelfamilien Lecanoraceae und Lecideaceae. *Beihefte zur Nova Hedwigia* 79: 241–371.
- Hertel H, Nash TH III, Ryan BD (‘2007’) [2008] *Catillaria*. Pp. 220–226 in Nash TH III, Gries C, Bungartz F (eds), *Lichen Flora of the Greater Sonoran Desert Region*. Vol. 3. (Lichens Unlimited, Arizona State University, Tempe)
- Jacobs SWL, Pickard J (1981) *Plants of New South Wales*. (D. West, Government Printer, Sydney)
- James PW, Galloway DJ (1992) *Menegazzia*. *Flora of Australia* 54: 213–246.
- Kantvilas G (2012) The genus *Menegazzia* (Lecanorales: Parmeliaceae) in Tasmania revisited. *Lichenologist* 44: 189–246. <https://doi.org/10.1017/S0024282911000685>
- Kantvilas G, Elix JA (2007) The genus *Ramboldia* (Lecanoraceae): a new species, key and notes. *Lichenologist* 38: 135–141. <https://doi.org/10.1017/S0024282907006469>
- Kantvilas G, van den Boom PPG (2013) A new species of *Catillaria* (lichenised Ascomycetes: Catillariaceae) from southern Australia. *Journal of the Adelaide Botanic Gardens* 26: 5–8.
- Kilius H (1981) Revision gesteinsbewohnender Sippen der Flechtengattung *Catillaria* Massal. in Europa. *Herzogia* 5: 209–448.
- Knudsen K, Standley SM (‘2007’) [2008] *Sarcogyne*. Pp. 289–296 in Nash TH III, Gries C, Bungartz F (eds), *Lichen Flora of the Greater Sonoran Desert Region*. Vol. 3. (Lichens Unlimited, Arizona State University, Tempe)
- Knudsen K, Kocourková J, Westberg W (2013) The identity of *Sarcogyne hypophaea* (Nyl.) Arnold. *Opuscula Philolichenum* 12: 23–26.
- Kondratyuk S, Lokös L, Tschabanenko S, Haji-Moniri M, Farkas E, Wang X, Oh S-O, Hur J-S (2013) New and noteworthy lichen-forming and lichenicolous fungi. *Acta Botanica Hungarica* 55: 275–349. <https://doi.org/10.1556/ABot.55.2013.3-4.9>
- Kondratyuk S, Lőkös L, Tschabanenko S, Moniri MH, Farkas E, Wang X, Oh S-O, Hur J-S (2016) New and noteworthy lichen-forming and lichenicolous fungi: 5. *Acta Botanica Hungarica* 58: 319–396. <https://doi.org/10.1556/ABot.58.2016.3-4.7>
- Lücking R (2008) Foliicolous lichenized fungi. *Flora Neotropica Monograph* 103: 1–867.
- McCarthy PM (2017) *Checklist of the Lichens of Australia and its Island Territories*. Version 12 April 2017. <http://www.anbg.gov.au/abrs/lichenlist/introduction.html> (Australian Biological Resources Study, Canberra)
- McCarthy PM, Elix JA (2014) Two new lichens from Mount Canobolas, New South Wales. *Telopea* 16: 119–125. <https://doi.org/10.7751/telopea20147757>
- McCarthy PM, Elix JA (2016) Five new lichen species (Ascomycota) from south-eastern Australia. *Telopea* 19: 137–151. <http://dx.doi.org/10.7751/telopea10732>
- McCarthy PM, Elix JA (2017) Two new species and a new record of Acarosporaceae (lichenized Ascomycota) from eastern Australia. *Australasian Lichenology* 80: 20–25.
- McCarthy PM, Kantvilas G (2013) Two new species of *Sarcogyne* (lichenised Ascomycota: Acarosporaceae) from central and southern Australia. *Journal of the Adelaide Botanic Gardens* 26: 15–21.
- McCarthy PM, Elix JA, Kantvilas G, Archer AW (2017) Additional lichen records from Australia 83. *Australasian Lichenology* 80: 62–77.
- Øvstedal DO, Lewis Smith RI (2001) *Lichens of Antarctica and South Georgia: A Guide to their Identification and Ecology*. (Cambridge University Press, Cambridge)



- Richardson RN, Richardson DHS (1982) A systematic list with distributions of the lichen species of Western Australia, based on collections in the Western Australian Herbarium. *Western Australian Herbarium Research Notes* 7: 17–29.
- Ryan BD, Tønsberg T, Nash III TH, Hafellner J (2004) *Pyrrhospora*. Pp. 436–439 in Nash III TH, Ryan BD, Diederich P, Gries C and Bungartz F (eds), *Lichen Flora of the Greater Sonoran Desert Region*. Vol. 2. (Lichens Unlimited, Arizona State University, Tempe)
- Thomson JW (1997) *American Arctic Lichens. 2. The Microlichens*. (The University of Wisconsin Press, Madison)
- van den Boom PPG (2004) *Fellhanera*. Pp. 107–108 in Nash III TH, Ryan BD, Diederich P, Gries C and Bungartz F (eds), *Lichen Flora of the Greater Sonoran Desert Region*. Vol. 2. (Lichens Unlimited, Arizona State University, Tempe)

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